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Gomphus pallidus and Two New Related Species (Odonata).

By E. B. WILLIAMSON, Bluffton, Indiana.

(Plates IV and V.)

Recently in identifying some dragon flies from Florida collected by my father, L. A. Williamson, I had occasion to study a pair of *Gomphus* taken in copulation by him at Salt Lake, St. Petersburg, Florida, March 31, 1913. These were evidently *G. pallidus* Rambur, but they certainly differed from specimens from Texas and Oklahoma which I had at an earlier date also determined as *pallidus*. When the Florida material was first studied I had referred all my material from Texas and Oklahoma to one species, and, with this idea in mind, I sent rough sketches of the two species to several students in the hopes of learning more of their distribution. Later, when the southwestern material was studied, two species were found to be included in it, to only one of which, *submedianus* n. sp., my

sketches applied. This correspondence, which will be referred to again, clearly indicates that in recent literature two or more species of dragon flies have been confused under the name of *pallidus*.

I have no doubt of the existence in the genus *Gomphus*, as generally used, of several subgroups, along the lines indicated by de Selys and Professor Needham. As soon as possible it will be convenient to use these subgroups as genera. But before this can be done an exhaustive study of the approximately seventy species involved will be necessary. At present no one can use these group names intelligently. These groups have been defined by Professor Needham, so far as imagoes go, in terms not used or emphasized by de Selys, whose groups were based largely on thoracic pattern, though the resultant groupings, in the two cases, have much in common. For example de Selys' Group 5 includes *pallidus* (and *villosipes*), *lividus*, *spicatus*, *mimitus* and *exilis*. *Arigomphus*, as used by Needham, includes *pallidus*, *villosipes*, *spicatus* and other species not known to de Selys in 1858, the date of the *Monographie*. *Lividus* and *exilis* are placed in another group by Needham, who has not discussed *minutus*.

As stated above the groups require accurate definition. So far as de Selys goes, *spicatus* and *exilis*, at least, should not be associated with *pallidus*; and in Needham's arrangement it is certainly a mistake to separate *exilis* and *spicatus*, for example. *Arigomphus* is defined (Aquatic Insects Adirondacks, p. 447-8) as having two cells between the base of veins A1 and A2 at their origin. Five males and one female of *villosipes*, selected at random, all have a single cell. Three males of *cornutus*, which is an *Arigomphus*, have two wings with one cell, and four wings with two. This character is tabulated below for the material discussed in this paper. To the shape of the apex of abdominal segment 8 some importance may attach, but the character is difficult of accurate definition (see Fig. 8, and explanation). As to the hind femora in the two sexes, I have examined thirty species of which I have both sexes, and the femora are different in the sexes in all of them. In the males

the last femur has short or very short subequal numerous spines or teeth, and no hair, sparse non-concealing hair, or long dense hair. In the females the spines on the apical half or two-thirds of the femur are longer and sparser than on the basal portion. But hairiness in the male is not a characteristic of *Arigomphus*. In fact, it is not evident why Professor Needham included *spicatus* in *Arigomphus*; and in *furcifer*, which I agree with him belongs in *Arigomphus*, the femur has very sparse hair, and the term hairy could better be applied to *viridifrons*, *brevis* and *abbreviatus*, for example. The position of the posterior hamule of the male seems a valuable character, though applicable only to the one sex.

Not wishing at this time to discuss these subgroups of *Gomphus*, it is nevertheless necessary, in order to give some idea of the relationships of the two new species described in this paper, to point out some characters which they possess in common with others of the genus. Briefly some of these characters are as follows: Thorax green, varying in shade with age, sex and species, and with distinct markings if present confined to the region of the mid-dorsal carina and the humeral suture. Face without dark markings. Legs robust, hind femora extending beyond the auricles; in the male with short subequal spines and more or less hair; in the female without hair, or with very sparse hair, and with unequal spines, many of which exceed the spines of the male and which are longest at about two-thirds the length of the femur. Posterior hamule of male directed posteriorly; posterior edge of seminal vesicle, seen in profile, distinctly concave or excavated. Vulvar lamina one-fourth to one-half length of segment 9, triangular, apex divided for a short distance with the branches pressed together or parallel. North America, east of the Rocky Mountains.

The species may be grouped as follows:

Legs dark, last femora black; *furcifer*, *villosipes*, *cornutus*, *lentulus*,¹ *australis*.¹

¹ *Australis* and *lentulus* are known to me only from descriptions. So far as I know, only the types are known, unless a male, referred by Muttkowski to *lentulus*, should prove to be that species (New Records

Legs paler, last femora largely pale; *pallidus*, *submedianus*, *subapicalis*.

MATERIAL EXAMINED AND LITERATURE.

Gomphus pallidus Rambur.

Through the great kindness of Mons. Guillaume Severin and Mr. Samuel Henshaw, I have been able to study the classical material of de Selys and Hagen. De Selys' material consists of one male and three females, including the two female types of Rambur. In addition Mons. Severin sent me the single specimen of *G. villosipes* in the de Selys collection. For convenience I have designated these specimens numerically.

De Selys 1,—*G. villosipes* male, a slightly teneral, badly faded specimen, labelled in de Selys' hand, "*G. villosipes* ♂, Philadelphia, Calvert."* This is lightly smaller and less robust than Pennsylvania, Ohio, Indiana and Illinois specimens in my collection. However, I believe all represent a single species.

De Selys 2,—labelled, "*Gomphus pilipes*. Hag. ♂ (♂ de *pallidus*.)" "N. America." "*Gomphus pallidus* R. ♂."

De Selys 3,—labelled "*Gomphus pallidus* R. ♀."

of Wis. Drf. Vol. IX, April 1911, Bull. Wis. Nat. Hist. Soc., pp. 36, 37, plate IV. "A single male in the Brooklyn Museum, locality unknown.") The type of *lentulus* is stated to be in the collection of Mr. C. A. Hart, but this is a mistake as the following quotation from a letter of April 21, 1913, from Mr. Hart shows: "As to *lentulus* a university student captured it, and I attempted to name it. It was badly broken and I attempted to mend it; in so doing I disturbed the genitalia, but as I had already studied these carefully and they seemed unlike anything I had ever seen, I managed to keep them about as they were. The question of the location of the type has come up before. I can only say that it is not in the State Laboratory Collections, so far as I know, and that I have no dragonfly collection." This loss is the more unfortunate from the fact that *lentulus*, like *australis*, was not figured, nor were characters for separating them from their closest allies pointed out. It seems to me that *australis* is probably not closely related to species included under *Arigomphus* in this paper. The larva of *australis* (supposition) is known, but it is possibly *pallidus*, since the Illinois specimens, described by Needham and Hart as *pallidus*, are not that species.

*[As I never obtained *villosipes* in Philadelphia, it is likely that this specimen is from one of the Pennsylvania localities cited on p. 245, Trans. Amer. Ent. Soc. vol. xx, with my original locality label displaced.—P. P. CALVERT.]

De Selys 4,—one of Rambur's types, labelled, "Collect Latreille," then below this is a red ink margined label, one end of which has been torn off, on which is written in red ink "Amer. Sept.," following which is some character which may be a continuation of the abbreviation of 'septentrionale,' but which resembles the figure 6 with a long comma or figure 7 below it as much as anything. It is hardly possible, however, that this is a date, September 6. Below this label is a small rectangle of gilt paper.

De Selys 5,—the other of Rambur's types, a small label "♀," below this a label similar to the red-inked label of the other type, but in this case the ink is faded to brown, and one end of the label is cut off obliquely, instead of being torn, on which is written a word the first four letters of which are plainly "Pari," but the last letter or character of which I cannot be sure; this is the label "Paris" of Rambur; below this label is a bit of gilt paper, as in the other type, and below this a long narrow label "*G. pallidus*." The entire abdomen of this specimen is lost.

Hagen's material consists of 3 males and 1 female: Hagen 1,—a tenereal male bears Hagen's printed label "Hagen" and "Florida, Thaxter."

Hagen 2,—a male in good condition, labelled "Ft. Reed, Fla., Apr. 26, '76," and "*Gomphus pallidus* Rbr."

Hagen 3,—a male, with abd. appendages broken off, labelled "New Orleans." "*G. pallidus* Rbr." "*Gomphus pilipes* Hagen, ♂ a vous" (on this label is glued the thoracic sclerite from between the front wings), "*G. pilipes* Sel." This is the type of *pilipes*.

Hagen 4,—a female in good condition, with the printed label "Hagen" and "*G. pallidus* Rbr., Georgia" and a word I cannot decipher followed by 7 (de Selys records *pallidus* from Georgia in May).

In my collection, a pair, in copulation, Salt Lake, St. Petersburg, Florida, March 31, 1913, L. A. Williamson.

The references to the literature of *pallidus* cited by Kirby, Catalogue p. 64, all relate to papers by de Selys and Hagen, and all I believe refer to true *pallidus*. In two places in the *Monographie* de Selys refers, apparently inadvertently, to *pallidus* as *pallens*, p. 148 (408), and 415 (675).

In the Dragonflies of Indiana, 1899, p. 291, and in Additions to the Ind. List, Proc. Ind. Acad. Sci., 1900, p. 176, two females from Elkhart Co., Indiana, collected by R. J. Weith are recorded as *G. pallidus*. One of these specimens is in the Phila. Acad. Nat. Sci. Collection and Dr. Calvert writes that the occiput is very close to my sketch of *submedianus*. It is probable that both Weith's specimens are *submedianus*.

Needham, Can. Ent. 1897, p. 166, and Needham and Hart, Bull. Ill. St. Lab. Sept. 1901, pp. 14, 16, 67, 77, 79-81 and 87, refer to Illinois specimens as *pallidus*. Letters were written to both Professor Needham and Mr. Hart. Professor Needham writes: "Clearly there are

two things we have been calling *G. pallidus*. I have male specimens from the type locality and both sexes from Florida that correspond exactly with your sketches of *pallidus*. I have many others from Galesburg, Ill. (determined long since, when I first began collecting, for me by Kellicott) that agree with your sketches of *submedianus*. And I have no intermediates." Mr. Hart kindly sent me drawings of the postocellary vertical ridge of the male and of the occipita of the 2 females in the State Laboratory Collection. Evidently the specimens are *submedianus*.

Calvert, Occas. Papers Bost. Soc. Nat. Hist. VII, 1905, p. 20, reports *pallidus* from Waltham, Mass. (Hagen). This record probably refers to true *pallidus*.

Dr. Calvert in addition to notes on the Weith specimen from Indiana, mentioned above, sent me notes on the other specimens in the Phila. Acad. Two males from Texas are *submedianus* or *subapicalis* (these two species were not distinguished in my correspondence with Dr. Calvert); a Florida male is intermediate, so far as my sketches of the postocellary vertical ridge go, between *pallidus* and *submedianus*, this specimen is doubtless *pallidus*. A female from Thomasville, Georgia, is *pallidus*.

Wilson, Drf. Cumberland Valley in Ky. and Tenn., Proc. U. S. Nat. Mus., September, 1912, pp. 192 and 199 states "that the river is entirely patrolled by *pallidus*." It is impossible to state what species is here referred to.

I wrote to Mr. Currie for data on *pallidus* in the U. S. Nat. Mus. A male, labelled Texas, is *submedianus* or *subapicalis*; a female from Missouri and a female from Henderson Co., Illinois, are *submedianus*. These are the only specimens under the label *pallidus* in the Nat. Mus. Three other references in literature to *G. pallidus* do not record anything of interest in this connection.

Gomphus submedianus n. sp.

Bay City, Texas, May 24, 1907, ♂ (type) and teneral ♀; Williams Lake, Matagorda, Texas, May 26, 1907, ♂; Wister, Oklahoma, June 3, ♀, and June 4, 1907, 3 ♂, 1 ♀. Association of the sexes supposition only. For literature see under *pallidus*. For description of localities see under *subapicalis*.

Gomphus subapicalis n. sp.

Bay City, Texas, May 24, ♂ (type), and May 27, 1907, ♀; Williams Lake, Matagorda County, Texas, May 26, 1907, ♂. Association of the sexes supposition only. For literature see under *pallidus*. On May 24 I collected near Bay City,

Texas, by pools along the railroad to Brownsville. Both *submedianus* and *subapicalis* were taken, but were not distinguished at the time. The two species were associated again at Williams Lake on May 26. On June 3 and 4 *submedianus* was taken at an artificial lake along the Frisco R. R. about 1½ miles north of Wister, Oklahoma.

CHARACTERS OF *PALLIDUS*, *SUBMEDIANUS* AND *SUBAPICALIS*.

Size.—Abdomen: *pallidus*, male 39-42, female 40-43; *submedianus*, male 38-41, female 39-42; *subapicalis*, male 39-40, female 40.

Hind wing: *pallidus*, male 31-33, female 34-36; *submedianus*, male 30-33, female 35-39; *subapicalis*, male 31-34, female 36.

Head.—Face unmarked, apparently yellowish green in *submedianus* and *subapicalis*, and paler green, without yellowish, in *pallidus*. In Rambur's types, de Selys 4 and 5, much discoloration is evident; in 4 entire face and frons above are brown; and in 5 the frons, both in front and above, is sharply brown. The color pattern of the frons at its base above is distinct in the three species; in *pallidus* there is a brown basal stripe of practically uniform width, if anything widest at the middle; in *submedianus* the stripe is distinctly notched or narrowed in front of the median ocellus; and in *subapicalis* it is reduced to two spots, one on each side of and in front of the median ocellus, these spots joined medianally in the single female. The entire vertex is dark brown, almost black, in *pallidus*; in *submedianus* it is paler, and the postocellary vertical ridge is still paler and greenish, only slightly darker, especially along the anterior border, than the frons and the occiput; *subapicalis* is fairly intermediate between the two others in this character. Fig. 28 is of the postocellary ridge in a Florida male of *pallidus*; Hagen's 1 and 2 have the ridge much like figure 31; *pallidus* and *submedianus* males which might be confused by the form of the appendages, are certainly clearly separated by the form and color of this ridge.

Thorax.—Green, apparently inclining to brownish in *pallidus* and yellowish green in the other two. So far as I can detect in the *pallidus* before me there is no dorsal stripe on either side of the carina, and the carina itself is pale excepting at the median angle. In *submedianus* and *subapicalis* the carina is dark above the median angle, and there is a very narrow dorsal stripe on either side, or this reduced to a vestige or, in one male of *subapicalis*, entirely wanting. (This variation, I believe, is not entirely due to post-mortem changes.) (In the single female referred to *subapicalis* the thoracic markings are the most developed of any specimen before me; in this case the dorsal stripes are wide and long, and closely approach the middorsal carina). Antehumeral brown stripe present (wanting in

some *pallidus* due to post-mortem changes or loss of thoracic contents), widest and most definite in *submedianus* and *subapicalis*. The humeral stripe, like the antehumeral, in *pallidus* is narrow, obscure, and scarcely evident; in *submedianus* it is reduced to a line, in striking contrast to the well developed antehumeral; in *subapicalis* it is nearly as wide as the antehumeral.

Venation between A₁ and A₂.

I. Two cells of about equal size in first series¹, A₁ angled²: *submedianus*, 2 male wings, 20%; *subapicalis*, 3 male wings, 75%.

II. Two cells in first series, the proximal one of these two long and narrow, A₁ not angled: *pallidus*, 9 male wings, 90%, 4 female wings, 40%; *submedianus*, 1 female wing, 16.7%.

III. One cell in first series, A₁ angled: *pallidus*, 1 male wing, 10%; *submedianus*, 8 male wings, 80%, 3 female wings, 50%; *subapicalis*, 1 male wing, 25%, 1 female wing, 50%.

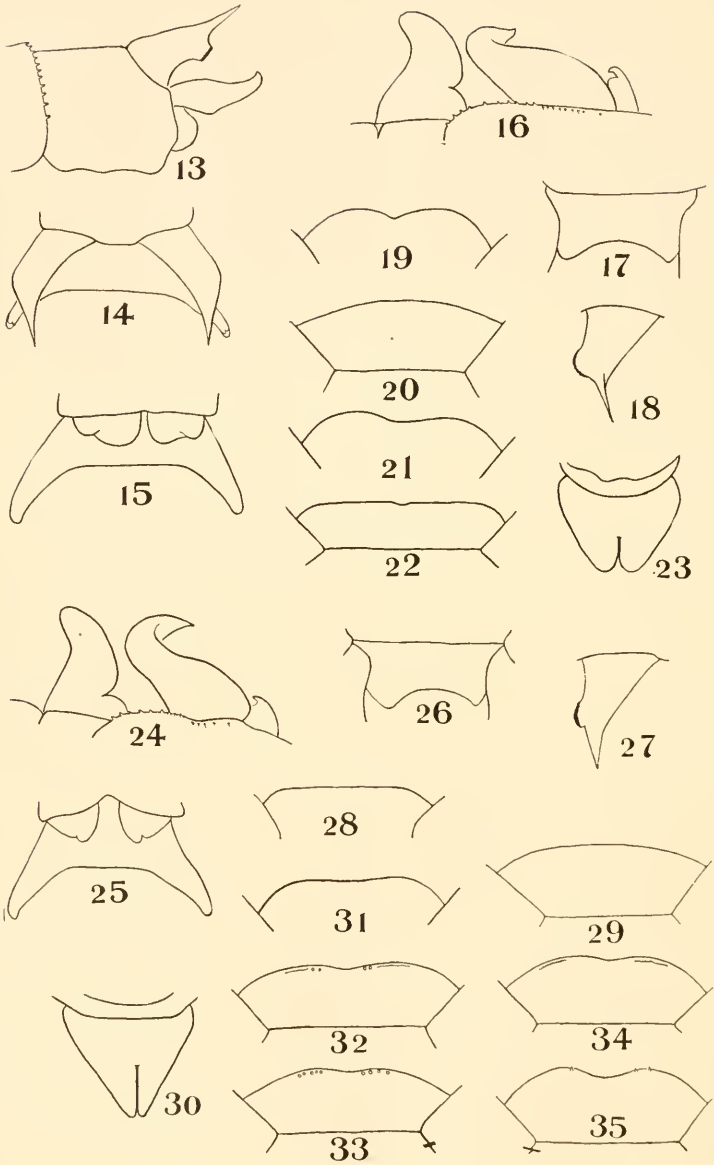
IV. One cell in first series. A₁ not angled: *pallidus*. 6 female wings, 60%; *submedianus*, 2 female wings, 33.3%; *subapicalis*, 1 female wing, 50%.

Legs.—Light brown in *pallidus*, femora darker apically and dorsally, tibiae gray dorsally, tarsus black, second joint of last tarsus gray, and first joint of same tarsus gray in the middle; last femora with some hair in the female, and in the male almost covered with brown pile. In the other two species the femora are not nearly so hairy, and there is a distinct color pattern of dark on a ground color paler than the light brown of *pallidus*. In *submedianus* the legs are green or yellowish green, the femora apically and dorsally black; the tibiae black ventrally and, in sharp contrast, yellow dorsally, tarsus patterned as in *pallidus*, but the middle joint of the middle legs shows more or less pale also; from the apical black of the last femur three fine lines run basally on the dorsal surface of the femur, two of these are anterior (external) and the other is posterior (internal), the apical black occupies 1 to 2 mm., and the black lines, except sometimes the most anterior one and the posterior one in the male, do not reach the base of the femur. *Subapicalis* is similar to *submedianus*, but on the last femora the apical black is more extensive and the lines are less developed, the posterior scarcely evident, and the two anterior lines shorter than in *submedianus*.

Abdomen.—The abdominal markings are generally obscure, ill-defined and difficult of description. Probably this is true of the majority of these insects in life, and more generally true of dried material. In the absence of any notes on living colors and with

¹In all wings examined there are 2 cells in the second series.

²A₁ varies from distinctly angled to straight in the entire series of wings examined, so the description as angled or straight is, in some cases, arbitrary.



GOMPHUS PALLIDUS, ETC.—WILLIAMSON.